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Extended abstract

In general, assembly manufacturing processes may be decomposed into a number (m) of workstations, i.e., process steps, each one potentially critical in generating defects [2,4]. In each workstation, different quality controls may be performed. Each i-th workstation can be described through three parameters [4]: (i) p_i: probability of occurrence of a defective-workstation-output; (ii) α_i: probability of erroneously signalling a defective-workstation-output after the control (i.e., type-I inspection error); (iii) β_i: probability of erroneously not signalling a defective-workstation-output after the control (i.e., type-II inspection error), where i=1,…,m. The first parameter (p_i) is a physiological characteristic of the process in normal working conditions, and can be *a priori* estimated using defect-generation models or empirical/simulation methods [3,5]. The estimates of α_i and β_i depend on the characteristics of the inspection procedure and the technical skills and/or experience of the inspector [1]. According to this model, two indicators which depict the overall effectiveness and economic convenience of an inspection strategy may be obtained

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[2]. The first one, D, is the mean total number of defective-workstation-outputs which are erroneously not signaled in all the inspections, defined as [4]:

$$D = \sum_{i=1}^{m} p_i \cdot \beta_i \tag{1}$$

The second one is the total inspection cost, C_{tot}, which can be expressed as [2,3]:

$$C_{tot} = \sum_{i=1}^{m} [c_i + NRC_i \cdot p_i \cdot (1 - \beta_i) + URC_i \cdot (1 - p_i) \cdot \alpha_i + NDC_i \cdot p_i \cdot \beta_i] \tag{2}$$

where c_i represents the cost of the inspection activity; NRC_i and URC_i are respectively the necessary- and unnecessary-repair cost; and NDC_i is the cost of undetected defects.

The proposed model and the two inspection indicators, reported in Eqs. (1) and (2), are supposed to have both an analytical and predictive connotation. According to a cost-benefit logic, the combined use of the inspection indicators allows the comparison of alternative inspection strategies in terms of effectiveness and cost, and the selection of the most appropriate according to the manufacturer requirements. This may represent a powerful and practical approach to assist inspection designers in early design phases of new assembly manufacturing processes. For instance, it may be adopted to choose between a complete inspection, i.e., when quality controls are performed after each workstation, and a partial inspection in selected workstations. Once the optimal strategy has been identified through the proposed method, it will be used each time an inspection activity is carried out. Since the proposed indicators enable the identification of the most critical workstations, more effective control procedures may be designed. Furthermore, as the assessment of inspection strategies is closely related to inspection errors α_i and β_i, a study on the impact that inspection errors have on inspection strategies selection is proposed.

The proposed approach may be exploited for a wide range of industrial processes, and is particularly useful in the case of short-run productions, for which most of the statistical process control techniques are unsuitable. In this work, a case study concerning the comparison of three alternative inspection procedures for a production of hardness testing machines is presented.

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